

OBRAMBNI SISTEM ČEBEL

Tadej MALOVRH¹

Izveček

Pri višjih vretenčarjih zelo dobro poznamo obrambni sistem telesa, ki ga imenujemo imunski sistem. Telesni obrambni sistem pri čebelah, ki so v živalskem deblu razvrščene nižje, med členonožce, pa je manj poznan. Žuželke, med katere uvrščamo tudi čebele, so biološko gledano v naravi zelo uspešni organizmi, ki imajo vsekakor dobro razvite mehanizme obrambe pred bakterijami, virusi, paraziti in glivami. Glavni medij, v katerem pri žuželkah potekajo obrambne reakcije pred patogeni je hemolimfa, ki obliva notranje organe čebele. Kako deluje obrambni sistem pri čebeli lahko sklepamo iz samih poskusov na čebelah ali pa preko spoznanj iz raziskav na drugih členonožcih (druge žuželke, raki, pajkovi). Obrambni sistem čebel v grobem delimo na socialni del, ki vključuje način vzgoje zaroda in higiensko (čistilno) vedenje čebel. Drugi, imunski del predstavljajo humoralne reakcije (melanizacija, delovanje protimikrobnih peptidov, koagulacije hemolimfe) in reakcije na ravni celic (fagocitoza, nodulacija, enkapsulacija). Elementi imunskega sistema čebele nastajajo v t.i. imunskih organih, ki jih predstavljata maščobno telo, v katerem nastajajo protimikrobni peptidi ter limfna žleza, kjer nastajajo hemociti. Žuželke pri obrambi proti virusnim okužbam uporabljajo mehanizme na temelju RNA interference, kjer v celicah kratki delčki RNA inhibirajo izražanje virusnih genov in s tem zavirajo pomnoževanje virusov. Na učinkovito delovanje obrambnega sistema pri čebelah pa vsekakor vpliva okolje, v katerem živi čebelja družina. Pomembna je pravilna prehrana, pri čemer ima omejevanje kaloričnega vnosa vpliv na imunske funkcije, saj ogljikovi hidrati zagotavljajo energijo za metabolične procese povezane s humoralnimi in celičnimi imunskimi reakcijami. Oskrba s proteinsko hrano in s tem z aminokislinami, je pomembna za sintezo protimikrobnih peptidov. Pomanjkanje proteinov v hrani vodi do nižjega deleža telesnih proteinov kot tudi protimikrobnih peptidov, posledično pa se izraža tudi na nižji telesni masi čebel. Vse več laboratorijskih študij dokazuje, da imajo različne kemične snovi iz okolja (tudi zdravila) negativen učinek tako na razvoj čebelje družine, na sposobnost učenja čebel, kot tudi na njihove imunske funkcije. Razumevanje delovanja telesne obrambe pri čebeli pospešuje raziskovanje na tem področju, ki je vsekakor zapostavljeno, saj se razvoj bolj usmerja v zdravljenje čebeljih bolezni, v nove apitehnične ukrepe in zaradi intenziviranja proizvodnje medu se iščejo ustrezni prehranski nadomestki. Pri vsem znanju se pozablja, kako takšni vplivi iz okolja učinkujejo na fiziološko delovanje posameznih elementov obrambnega sistema telesa čebele. Učinkovit obrambni sistem, pravilna uporaba zdravil in prehranskih nadomestil ter primerni apitehnični pristopi so ključ do zdrave in visoko proizvodne čebelje družine.

Ključne besede: čebela, obrambni sistem, hemolimfa, hemociti, protimikrobni peptidi

BODY DEFENCE SYSTEM IN THE HONEY BEE

Abstract

Body defence system in higher vertebrates is studied well and is known as the immune system. However, body defence system in honeybees that are ranked lower in the animal phylum, among arthropods, is less known. Insects, among which the honeybees are classified, are, biologically speaking, very successful organisms in the nature with defence

¹ Prof. dr., Veterinarska fakulteta, Nacionalni veterinarski inštitut, Gerbičeva 60, 1000 Ljubljana

mechanisms that are certainly well-developed against bacteria, viruses, parasites and fungi.

Haemolymph surrounds the internal body organs of honeybees. It is thus the main insect body tissue where defence reactions against pathogens take place. The physiological function of the honeybee body defence system is studied by actual experiments on bees or through findings of researches carried out on other arthropods (other insects, crustaceans, arachnids). The honeybee defensive system can be roughly divided into the social part, which includes the method of nursing larvae and the hygiene (cleaning) behaviour. The other, i.e. the immune part, is represented by humoral reactions (melanisation, antimicrobial peptides, hemolymph coagulation) and cellular-based reactions (phagocytosis, nodulation, encapsulation). Elements of the honeybee immune system are generated in the so-called immune organs that represent a fatty body which generates antimicrobial peptides, and lymph glands, which generate haemocytes. In defending against viral infections, insects activate mechanisms based on the RNA interference, where, in the cells, short pieces of RNA block the expression of viral genes and thus inhibit the multiplication of viruses. Effective functioning of the defence system in honeybees is under the influence of the environment where a honeybee family lives. Proper nutrition is important, where the restriction of caloric intake affects the immune function, as carbohydrates provide energy for metabolic processes associated with the humoral and cellular immune reactions. The supply of protein foods and thus of the amino acids is important for the synthesis of antimicrobial peptides. Lack of protein in food leads to a lower share of body proteins as well as of antimicrobial peptides, and is, consequently, reflected in the lower body mass of honeybees. In addition, an increasing number of laboratory studies shows that different chemical substances from the environment (including drugs) have a negative impact on the development of honeybee colonies, on the learning ability of honeybees as well as on their immune function. Understanding the functioning of body defence in honeybee stimulates the research in this area, which is definitely neglected since the development is more directed towards the treatment of honeybee diseases, concerning new apitechnical measures while there is a need for suitable nutritional supplements due to the intensification of honey production. Despite all the knowledge, we tend to forget how such environmental influences affect the physiological functioning of single elements of the body defence system of honeybees. Effective defence system, correct use of medicines and dietary supplements as well adequate apitechnical approaches are the key to a healthy and highly productive honeybee family.

Key words: honey bee, defence system, haemolymph, haemocytes, antibacterial peptides